Soft budget constraints in a dynamic general equilibrium model

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Abstract

This paper considers an overlapping generations model in which capital investment is financed in a credit market with adverse selection. Lenders' inability to commit ex-ante not to bailout ex-post, together with a wealthy position of entrepreneurs gives rise to the soft budget constraint syndrome, i.e. the absence of liquidation for poor performing firms on a regular basis. This problem arises endogenously as a result of the interaction between the economic behavior of agents, without relying on political economy explanations. We found the problem more binding along the business cycle, providing an explanation to creditors leniency during booms in some Latin-American countries in the late seventies and early nineties.

JEL Codes: E22, E44, D21, D82.

1 Introduction

In this paper we propose a dynamic general equilibrium model of an economy suffering from the soft budget constraint (SBC) syndrome. The setting is a neoclassical growth model with overlapping generations, where physical capital is financed through a credit market with adverse selection. We follow an

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economic-based approach of the syndrome, in line with the literature originated in Dewatripont-Maskin (1995), excluding political explanations. For the general equilibrium setting we draw on Bernanke and Gertler (1989), who consider the effects of a costly state verification setting in the credit market on capital investment and on business cycles. We also follow Azariadis and Chakraborty (1999) who, in a similar model, incorporate a richer specification of verification costs. In this sense, our model continues this tradition that states the relationship between borrowers' net worth and macroeconomic activity.

Our results point out that refinancing of inefficient projects (soft budget constraint) happens, and that it is more likely during expansions. In other words, periods of *bonanza* are characterized by more indulgent credit market conditions that are translated into more refinancing. In particular, entrepreneurial wealth plays a key role in this result, since it is the link between the performance of the economy as a whole and the investment decisions entrepreneurs take. That is, borrowers net worth during expansions is high and this facilitates lending. This link has also been mentioned in the literature of lending booms, for example in Gourinchas et al (2001). They identify the pattern of typical lending booms, by proposing an empirical analysis of such episodes around the world. The causes of lending booms are a combination of imperfections in the financial architecture and misaligned incentives at the microeconomic level (e.g. a poor regulation of the financial sector, a dampened monitoring activity, the expectation of a future bailout from the government) that implies riskier projects are undertaken. This configuration has been found, in particular for the Latin American experience, after a financial liberalization.

Soft budget constraint

The term soft budget constraint has initially been used by Kornai (1979) in the description of economic behavior in socialist countries. Those centrally planned economies were characterized by a lack of financial discipline of their state-owned firms. Firms used to anticipate that any loss would be covered by the central planner, and this lowered their incentives to pursue good management practices. These expectations were confirmed and fed by persistent state bailouts, that became a way to avoid liquidation: firms were not allowed to fail. Soft budget constraint is in fact a theory of survival and exit. As Kornai (1998) points out:

> *Economic theory deals at length with the creation side.(...) The concept of SBC focuses on the destruction side. Will an organization live forever? If it is to die, will it die a natural death or will it be sustained artificially for some period of time by state support through the SBC?*

Since then the concept has been increasingly used in the economics of transition from centralized to decentralized economies, and it has not been absent in market economies neither. There has also been evidence of soft budget constraint in recent episodes in Latin American countries. It is the case of Uruguay, where we find periods of credit boom accompanied by refinancing of inefficient projects in the late seventies and early nineties; huge bailouts to the banking sector during the eighties; a massive program of private debts refinancing by means of law; bailouts of the central government to sub-national ones; and tax arrears between government agencies. We may cite the case of Argentina as well, this time mainly in the form of private debt refinancing during the late seventies and early eighties. It seems then that the syndrome has been present under several configurations and also in different general economic conditions i.e. during expansions and recessions.

Kornai, Maskin and Roland (2003) propose an exhaustive review of the *state of the art* of the literature, providing a characterization of the problem, its main ingredients, and its most common applications. The syndrome is at work when a *support organization* (usually governments or their agencies, banks, firms) rescues a *budget-constrained organization* (usually firms, but also non-profit organizations) on a regular basis. Examples of those pairs are banks and firms; central banks and banks; governments and its agencies (health, social security systems); central governments and sub-national ones, international financial agencies and countries. A key ingredient is expectations about a future rescue. That is, we cannot talk about soft budget constraint syndrome just when an organization receives financial help from another once. What is important is having a recurrent phenomenon of rescue, which in turn creates an expectation among agents that a future bailout may occur. In that setting, the "inability to prevent an ex-ante financial plan from being renegotiated ex-post" plays a key role in the occurrence of a rescue. There is hence a problem of temporal inconsistency of decisions, in which ex-ante threats by support organizations are not credible enough so as to prevent bad behavior of budget-constrained organizations.

The *motives* for softness are multiple. Following Kornai, Maskin and Roland (2003), we can mention political factors and economic factors. These are actually the two main avenues the literature has been taken since its origins. Regarding political factors we can mention the need to maintain a given employment level, social stability, or directly as a result of the state paternalism over emblematic state-owned firms. Lobbying activities conducted by interest groups in order to keep inefficient firms at work also belong to this category. Economic explanations emphasize the phenomenon is an endogenous outcome in the relationship between a support organization and a budget-constrained one. Indeed, it can be the case that extending financial help to a loss-maker firm is in the best business interest of the support organization. This literature is originated by Dewatripont and Maskin (1995) in the context of credit markets with adverse selection.

The *means* of softness are also various, and can be grouped into two main categories. On one hand there are fiscal means such as subsidies, or tax concessions. On the other hand, we have credit means like soft loans, i.e. loans given to non-performing firms with special favorable conditions, and trade credit arrears.

The soft budget constraint *mentality* is then characterized by the expectations a budget-constrained organization has of a future rescue. When firms anticipate this possibility, their conduct is usually distorted. Some examples of the effects of the syndrome on the behavior of organizations are, for different contexts, an attenuation of managerial effort; a weakening of research and development activities; a search for political favors instead of focusing on markets; an increase in the demand of inputs (when they are paid by the support organization); and a decrease in screening and monitoring of projects.

Among the literature on soft budget constraints applied to credit markets there is a set of papers that follows the Dewatripont-Maskin (DM) model. The basic setting includes entrepreneurs endowed with *Good* and *Poor* projects, which are respectively efficient and inefficient, and lenders that –given adverse selection– may initially fund and even refinance inefficient projects. There is no government, the decision to refinance is linked to the existence of sunk costs, which implies a redefinition of the profitability criterium. Ex-ante, lenders do not want to fund inefficient projects, hence they are willing to deter *Poor* projects to be submitted through a threat of termination. However, in the event that lenders have initially funded such projects, that threat could well not be credible. Ex-post, that is after default occurred, and given that initial funding is considered as sunk, it can be the case that bringing *Poor* projects to completion (by injecting new funds) is in everybody's best business interest. Lenders would recover some of the incurred losses, while entrepreneurs usually have enough incentives to see their projects finished rather than liquidated. Being aware of these mechanisms at the contracting stage, entrepreneurs endowed with *Poor* projects may be tempted to submit them. In such a context of agents rationality and profit maximizing behavior, one of the puzzles is to find out why soft budget constraints are not so prevalent under a capitalist economy. In Dewatripont and Roland (1999) an answer is advanced stating that hardening soft budget constraints is a matter of institutional design.

We find in this DM tradition models of soft budget constraint applied to different settings, but mainly focused in credit markets. Berglöf and Roland (1997) point out that refinancing *Poor* projects may crowd out investment when the average quality of new projects is low enough, hence giving an explanation to the coexistence of soft budget constraints and credit crunches. Bergara, Ponce and Zipitría (2003) propose a unified framework to study both political an economic-induced softening. Mitchell (2000) proposes a new taxonomy of models based on ex-ante and ex-post efficiency criteria that allows to identify two classes of models. Indeed, not all SBC configurations incorporate ex-post efficiency as in DM, but it can also be the case of ex-post inefficiency. She then provides an example of the latter, in the context of banking crises, through a model of the SBC where creditor passivity –under the form of debt rolling over– has the leading role on explaining the softening.

This paper is organized as follows: in section 2 we present the general equilibrium setting with a description of agents, technologies, preferences and environment. Section 3 explains the credit market characteristics, and presents the full information and imperfect information cases. In section 4 we show how capital is determined in each period. Section 5 analyzes the effects of the syndrome in the general equilibrium setting. Section 6 explores the dynamic properties of the model, and proposes an example to obtain a steady state. Section 7 tests the empirical predictions of the model. Finally, Section 8 concludes.

2 The model

Consider an overlapping generations (OLG) model with constant population in which each generation lives two periods. Each individual receives a labor income when young, and saves in order to consume when old. There are no bequests. Time is infinite in the forward direction, divided into discrete periods indexed by t. In what follows we complete the description of this economy.

Agents. There is a countable infinity of individuals who are divided into two classes of agents: an exogenous fraction η is endowed with an investment technology through which physical capital is built. These agents are called entrepreneurs. The remaining fraction $1-\eta$ are households, which we call lenders since they are credit suppliers. Among entrepreneurs we will distinguish between *Good* and *Poor* ones, as will be defined later. All agents are risk-neutral.

Endowments. Every individual (entrepreneur or lender) has a fixed labor endowment to be used in his first period of life. This endowment is constant across time, $L_t = L$.

Preferences. Entrepreneurs and lenders have different preferences and are also distinguished by a different access to the credit market. Entrepreneurs only consume when old, they are second-period expected consumption maximizers. The only use of their savings when young is their conservation by means of a storage technology. This storage technology available for entrepreneurs, due to capital market imperfections, is called "primitive", since one unit of the output good stored when young yields only $1+\hat{r}=\hat{R}<1$ when old. The entrepreneurs' first period savings are equal to their labor income

$$s_t^E = w_t L, \tag{1}$$

where w_t is the wage rate, competitively determined as the marginal productivity of labor.

Lenders consume both when young and old, and have access to a storage technology that yields the gross payoff $1+r=R>1$ per unit of the output good. Their preferences are represented by

$$U(c_t^y) + \rho E_t(c_{t+1}^o), \tag{2}$$

where c_t^y is lender's consumption when young and c_{t+1}^o is their consumption when old. U is concave and ρ is a discount factor. Note that lenders are risk-neutral with respect to second period consumption. This assumption allows us to avoid risk-sharing considerations. Lenders' consumption and savings will depend then on the relevant interest rate as well as on the wage rate. Calling $c_y^*(R)$ the optimal consumption of lenders when young, first-period savings by this class of individuals is given by:

$$s_t = w_t L - c_y^*(R). \tag{3}$$

We will work under the simplifying assumption that total lenders' savings in this economy are high enough so as to fund all projects. In terms of the model, we suppose that the proportion $(1-\eta)$ of lenders is large enough, with the consequence that there is always a positive level of storage and the marginal rate of return for lenders is R.

Goods and technologies. There are two goods in this economy: an output (or consumption) good and a capital good. The output good is produced using a constant returns to scale technology that uses both the capital good and labor as inputs. We write the production function in per capita terms:

$$y_t = \tilde{\epsilon}_t f(k_t), \tag{4}$$

where f is concave, k_t is per capita physical capital (assumed for simplicity to be fully depreciated in one period), and $\tilde{\epsilon}_t$ is a random aggregate productivity shock, which is i.i.d. over time and continously distributed over a finite positive support, with mean ϵ. Labor supply is fixed, as we have mentioned above.

The output good produced in period t can be used during the same period either to consume, to lend to entrepreneurs, or to store using a storage technology, that allows to have funds at $t + 1$.

The physical capital good is produced by entrepreneurs, who own the technology that come into the form of "investment projects". These investment projects last one period, need one unit of the output good as initial investment, and can be either *Good* or *Poor*: while the former yield positive net present values, the latter do not[1]. We identify a *Good* entrepreneur as an entrepreneur who owns a *Good* project, and the same applies for *Poor* entrepreneurs.

Environment. This economy can be characterized by some features which best fit to a developing country, in particular in what concerns to imperfect capital markets. First, we work with the assumption that there are rigidities in the credit market that translate into the existence of different storage technologies for lenders and entrepreneurs. It is well known that such imperfections are common in many third world economies, in which some agents have access to international competitive markets, while others have only access to native capital markets. The latter are characterized by the presence of non-competitive practices, credit constraints, administrated interest rates, lack of arbitrage, among other imperfections. This will allow us to fully separate the roles of lenders and entrepreneurs. Second, lenders are disperse and thus passive, they do not have any screening or monitoring device that would allow them to better discrimi-

[1]By using the term *Poor* instead of, for example, *Bad*, we are simply adopting the terminology used in the literature on soft budget constraint. *Poor* projects are in fact *Bad* ones.

nate between *Good* and *Poor* projects. Third, we introduce the assumption that entrepreneurial saving, despite being known at the contracting stage, is not available at that time but only at an interim stage. As a result, entrepreneurs cannot use it as a contribution to the project's initial investment, and lenders have to entirely finance them. Finally and for simplicity, we rule out any possibility that entrepreneurial saving may be contracted upon. Again, these last two assumptions are adequate in the context of underdeveloped economies, characterized by poor institutional frameworks and inefficient judiciary procedures. In sum, these assumptions serve the purpose of facilitating the analysis and at the same time they adjust our setting to the Dewatripont-Maskin basic framework.

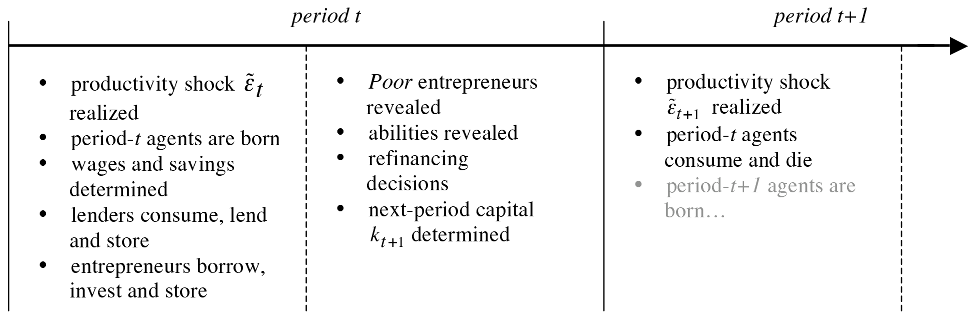

Figure 1: The life of agents

Figure 1 illustrates the life span of agents, the main features of the general equilibrium setting, together with the decisions agents take at each time. At any period t a new generation of lenders and entrepreneurs are born, who coexist with period-$(t-1)$ born agents (old agents in period t). Production is done with the labor endowment of generation t together with the capital built in period $(t-1)$, and the realized value of the productivity shock $\tilde{\epsilon}_t$, as equation (4) establishes. New agents receive their labor income and old agents their capital factor retributions. Period-t lenders consume, lend to entrepreneurs and store. Entrepreneurs borrow from lenders and store. Since this relationship is plagued by adverse selection and the soft budget constraint syndrome, some *Poor* projects may get funding and even end up refinanced and thus completed. At the end of period t, next period physical capital k_{t+1} is determined. When this generation arrives to old, in $(t+1)$, new production is realized and these agents receive their capital returns which, added to the returns from storage determines their consumption when old.

3 Credit Market

We now describe the credit market, in which entrepreneurs and lenders meet to fund projects. In doing so we are in a partial equilibrium framework, this means that the level of entrepreneurial savings s_t^E, the productivity shock $\tilde{\epsilon}_t$, the wage rate w_t, the expected relative price of capital $\hat{q}_{t+1}$ are all taken as given.

The key feature of this borrower-lender relationship is given by the presence of asymmetries of information between both types of agents. Indeed, we assume that at the contracting stage lenders are not able to distinguish between a *Good* and a *Poor* project, which is then the entrepreneur's private information. Lenders face a pool of applicants for funding, and they do know that a given project has a probability α of being *Good* and $(1-\alpha)$ of being *Poor*.

Both *Good* and *Poor* projects need an initial investment of one unit of the output good. Since the level of entrepreneurial savings –despite being known– is not available at the contracting stage, this initial investment is entirely provided by lenders. A given project –if completed– yields with certainty κ units of physical capital at the end of the period, to be sold at price q_{t+1} in the next one. The gross expected payoff of a completed project is then $\hat{q}_{t+1}\kappa$, where $\hat{q}_{t+1}$ denotes the expected (as of period t) relative price of capital.

The *Poor* project technology is only distinguished from the *Good* one by the fact that, at an interim stage, an extra injection of funds is required in order to bring the project to completion. If this is the case, it yields the gross expected payoff $\hat{q}_{t+1}\kappa$, just as the *Good* project. It is otherwise impossible to continue it, and the liquidation value is given by a fixed amount R_L which is entirely seized by lenders. At the interim stage, we can distinguish between *Good* and *Poor* projects, since *Poor* entrepreneurs need extra funding in order to complete their projects and thus they will ask lenders for refinancing.

Good **projects.** If the project is *Good*, it produces κ units of physical capital at the end of the period, yielding the following expected net present value[2]:

$$E(NPV_G) = \hat{q}_{t+1}\kappa - R. \tag{5}$$

And we assume

Assumption 1 $E(NPV_G) > 0$.

We will insure below that this assumption holds. The fact that the relevant price is $\hat{q}_{t+1}$ also simplifies the analysis, since all the decisions taken in t depend only on expectations about the next-period productivity shock (i.e. on ϵ, which we assume fixed), rather than on its actual value (i.e. on $\tilde{\epsilon}_{t+1}$).

Poor **projects.** The amount of extra funds needed by *Poor* projects will in turn depend on *Poor* entrepreneurs' own characteristics: we assume that the class of *Poor* entrepreneurs is itself not homogeneous. This heterogeneity comes from the fact that each *Poor* entrepreneur has an idiosyncratic characteristic that reflects his ability to complete the project. At the contracting stage, a representative entrepreneur of this class knows he has a *Poor* project, but he does not know how well he will perform in taking the project to completion. He needs to invest himself into the project, learn by doing, in order to know more and find out his level of ability. We assume hence that abilities are unknown at the contracting stage, and that this is particularly true for *Poor* entrepreneurs themselves. At the interim stage, this process of information acquisition is completed and abilities become publicly observed[3].

Then, different abilities will be translated into different needs of funds at the interim stage, in a way that a highly skilled entrepreneur needs less funds to complete the project. We have thus an opposite correspondence between these two variables. *Poor* entrepreneurs are indexed by i, and ability (extra funding) is

[2]We should interpret "present" as corresponding to values at period $t + 1$.

[3]Another interpretation for this feature would be an exogenous liquidity shock affecting *Poor* entrepreneurs during the first period, as in Aghion et al (2005).

represented by the parameter θ_i. Let us assume that it is uniformly distributed in the interval $[\underline{\theta}, \bar{\theta}]$ among *Poor* entrepreneurs, with $\bar{\theta} - \underline{\theta} = 1$.

Assumption 2 $E(NPV_{P_i}) < 0 \;\; \forall \, \theta_i$[4].

The expected net present value of agent i's *Poor* project is

$$E(NPV_{P_i}) = \hat{q}_{t+1}\kappa - R(1 + \theta_i) \tag{6}$$

It is then ex-ante inefficient to refinance a *Poor* project, and it follows that an entrepreneur with a low value of θ is "less inefficient" in the continuation activity.

However, under some circumstances it may be the case that lenders are willing to refinance *Poor* projects at the interim stage. Such a situation describes a *soft budget constraint episode*, in which there is a discrepancy between the ex-ante and ex-post criteria: despite the project is *Poor* and thus it should be liquidated, it may occur that it could be efficient ex-post, i.e. once default occurred and the initial investment is considered as sunk. In such a case, in their quest to recover some of the initial sunk investment, lenders will only pay attention to the continuation and liquidation payoffs, the latter given by a fixed amount $R_L < 1$.

Assumption 3 $\hat{q}_{t+1}\kappa - R\underline{\theta} < R_L$.

This equation tells us that –absent any entrepreneurial contribution– it is optimal for lenders to liquidate *Poor* projects, since in such a case the liquidation payoff is higher than the continuation payoff[5]. The refinancing decision will be then based on an entrepreneur's contribution: the entrepreneur is called to put up a part of his savings ($\tilde{s}_t^E$) in order to be refinanced.

Assumption 4 *Lenders have all the bargaining power in this credit relationship, so they can make take-it-or-leave-it offers to entrepreneurs. By this fashion,*

[4] The expected value of the random shock is set to $\epsilon = 1$. Then we assume $\frac{R}{\kappa f'(\kappa\eta)} < 1 < \frac{(1+\underline{\theta})R}{\kappa f'(\alpha\kappa\eta)}$, which is sufficient to guarantee the existence of both Good and Poor projects. This is valid for some reasonable parameter configurations.

[5] To guarantee Assumption 3 holds, and given the assumptions on ϵ it is sufficient to add the assumption $R < \frac{R_L}{1-\alpha\underline{\theta}}$.

lenders are capable to appropriate all the projects gross verifiable revenue. This verifiable payoff is a fraction γ of the total gross payoff.

We are assuming that entrepreneurs, given their direct involvement in the projects management, are able to deviate to their pockets a fixed proportion $(1-\gamma)$ of the projects gross payoff.

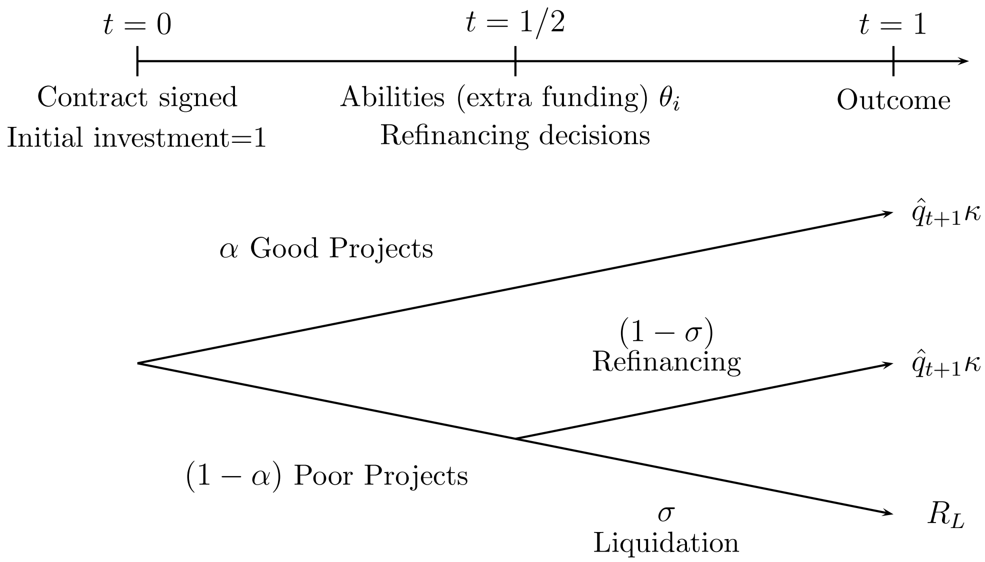

Figure 2: Credit market timing

In sum, the timing is as follows, as we can see in Figure 2. At the contracting stage, lenders and entrepreneurs meet to fund projects. The level of current entrepreneurial savings is publicly observed but it is not yet available, so it cannot be used to be invested into projects and thus lenders provide the entire initial investment. Entrepreneurs' abilities are unknown for every agent –including *Poor* entrepreneurs themselves– but their distribution is common knowledge. Both lenders and entrepreneurs take the decisions of respectively fund any type of projects, and submit their projects for funding. At the interim stage, *Poor* projects can be distinguished from *Good* ones, and each *Poor* entrepreneur is characterized by his level of ability. Lenders ask for an entrepreneurial contribution in order to refinance such projects, otherwise there is liquidation for a fraction $\sigma(s_t^E)$, to be defined below. Abilities, together with the level of entrepreneurial savings, may determine that some *Poor* entrepreneurs will be able to get refinancing.

3.1 The perfect information case

For ease of notation and given that we are in partial equilibrium, we refer to the gross payoff of a terminated project as $R_S = \hat{q}_{t+1}\kappa$, we use the subscript S for successful projects (either *good* projects or *poor* projects that are refinanced). If the project is liquidated, we keep R_L. We also use superscripts to denote the agent (lenders: L, entrepreneurs: E).

Let us first introduce the perfect information case. In this setting, lenders can observe the type of projects entrepreneurs have, hence they will only fund *Good* projects. Lenders' expected profits write:

$$E(\Pi_S^L) = \gamma R_S - R > 0, \tag{7}$$

whereas entrepreneurs get the remaining $(1-\gamma)R_S$ as gross payoff (equal to the net payoff, since they do not contribute to funding).

The supply of physical capital is given by the following curve, that we call hereafter the SS curve:

$$k_{t+1} = \alpha\kappa\eta. \tag{SS}$$

The next-period stock of (per capita) capital k_{t+1} is fixed, and is given by the units of physical capital a *Good* project can create (κ), multiplied by the total number of such projects in the population, $\alpha\eta$. On the other side, the demand curve DD is given by equality between the expected price of capital and its expected marginal productivity.

$$\hat{q}_{t+1} = \epsilon f'(k_{t+1}). \tag{DD}$$

This curve is downward sloping since f is concave, and recall that ϵ is the mean of the productivity shock. In each period t, $\hat{q}_{t+1}$ and k_{t+1} are determined as the intersection of the supply and demand curves of capital, as Figure 3 shows.

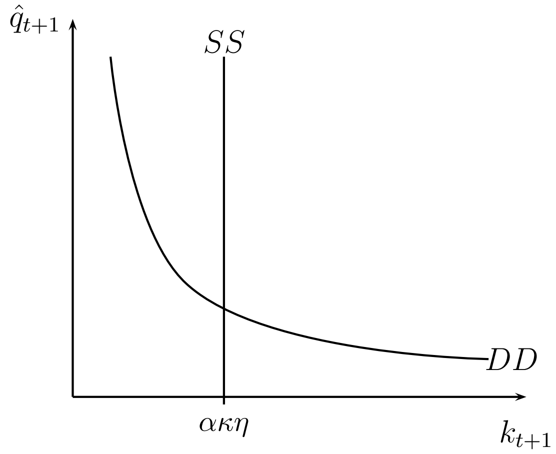

Figure 3: Equilibrium in the perfect information case

The dynamics in the full information case are simple: since no period-t variable is involved in SS and DD, both the expected price and the quantity of physical capital will be constant over time. Investment is then fixed, and reminding that labor supply so is, the only origin of fluctuations comes from the aggregate productivity shock $\tilde{\epsilon}_t$. With full information, all *good* projects are already financed, therefore any extra funds will serve to increase consumption as well as storage.

3.2 The asymmetric information case

When entrepreneurs types are not observable, lenders decide at the contracting stage whether to fund any project they face, and entrepreneurs decide whether to submit their projects to funding. At the interim stage, when all the information becomes publicly observed, lenders decide whether to extend extra funding to *Poor* projects, while *Poor* entrepreneurs themselves decide on continuing or not.

3.2.1 Lenders' financing and refinancing decisions

Lenders financing decisions depend on the mix of *Good* and *Poor* projects existing in the economy as well as on the refinancing conditions that will appear at the interim stage. By the moment let us say that, for a particular lender to finance any project, the net expected profits from funding a project must be at least equal to zero,

$$E(\Pi^L) = \alpha E(\Pi^L_G) + (1-\alpha)E(\Pi^L_P) \geq 0. \tag{8}$$

Total net expected profits are composed by the net expected profits from funding a *Good* project (with probability α) and the net expected profits from funding a *Poor* project (with probability $(1-\alpha)$). The expected profits from funding a *Good* project are given by

$$E(\Pi^L_G) = \gamma R_S - R > 0. \tag{9}$$

For *Poor* projects, we need to analyze what happens at the interim stage, when lenders observe the type of entrepreneur they have funded. Recall that it is at this time possible to distinguish within *Poor* entrepreneurs according to their level of ability. It is time for lenders to take a decision concerning refinancing or liquidating them. At a first sight, taking into account that a *Poor* project is –by definition– a negative expected present valued one, liquidation would seem like the best strategy for lenders.

However, given the sunk nature of the initial investment, it could be the case for refinancing. As we have already mentioned, there is no possibility of refinancing without an entrepreneurial contribution, since in such a case the lender's liquidation payoff is greater than the continuation one. Then, in order for continuation to occur, the entrepreneur should contribute with an amount $\tilde{s}^E_t$ of her savings, leaving the remaining amount $\theta_i - \tilde{s}^E_t$ at charge of the lender. Entrepreneurs may then make the lender's refinancing payoff greater than the liquidation payoff, forcing the project's continuation whenever

$$\gamma R_S - R(\theta_i - \tilde{s}^E_t) \geq R_L. \tag{10}$$

From the point of view of lenders, an entrepreneurial contribution that makes this inequality binding would be enough to extend refinancing[6]. Let us then define, for a given level of entrepreneurial savings s_t^E the threshold θ^s as the marginal *Poor* entrepreneur, that is, the one who leaves the lender indifferent between continuation and liquidation (equation (10) is binding),

$$\theta^s(s_t^E) = \frac{\gamma R_S - R_L}{R} + s_t^E. \tag{11}$$

It follows that any *Poor* entrepreneur with level of ability $\theta_i \leq \theta^s$, which we call *high-ability* entrepreneurs, has enough assets so as to be refinanced, whereas the contrary applies for $\theta_i > \theta^s$ which we call *low-ability* entrepreneurs[7].

With the above facts, define $\sigma(s_t^E)$ as the fraction of *Poor* entrepreneurs that will be liquidated

$$\sigma(s_t^E) = \int_{\theta^s(s_t^E)}^{\bar{\theta}} f(\theta)d(\theta) = \bar{\theta} - \theta^s(s_t^E), \tag{12}$$

and the fraction $(1-\sigma)$ of *Poor* entrepreneurs that will be refinanced,

$$1 - \sigma(s_t^E) = \int_{\underline{\theta}}^{\theta^s(s_t^E)} f(\theta)d(\theta) = \theta^s(s_t^E) - \underline{\theta}. \tag{13}$$

The values these fractions will take depend on the current value of entrepreneurial savings s_t^E, which is known at the contracting stage[8].

Given that lenders are passive, the necessary amount $\tilde{s}_t^E$ that an entrepreneur $\theta_i \leq \theta^s$ must contribute with in order to be refinanced is given by

$$\tilde{s}_t^E = \tilde{s}_t^E(\theta_i) = \theta_i - \frac{\gamma R_S - R_L}{R}, \tag{14}$$

which follows from equation (10). On the other hand, lenders will cover the remaining

$$\theta_i - \tilde{s}_t^E(\theta_i) = \frac{\gamma R_S - R_L}{R}. \tag{15}$$

Table 1 summarizes the findings of this subsection[9].

[6]We assume that, if indifferent between continuation or liquidation, lenders decide to go ahead with the project.

[7]$\theta^s(s_t^E)$ is interior, i.e. $\theta^s(s_t^E) \in (\underline{\theta}, \bar{\theta})$, if $s_t^E \in (\underline{\theta} - \frac{\gamma \hat{q}_{t+1}\kappa - R_L}{R}, \bar{\theta} - \frac{\gamma \hat{q}_{t+1}\kappa - R_L}{R})$, otherwise it adopts the respective bound.

[8]σ is interior, i.e. $\sigma \in (0,1)$ for $\theta^s(s_t^E)$ interior.

[9]For notation clarity, we omit hereafter the dependence of σ on entrepreneurial savings s_t^E.

Table 1: Decisions at interim stage

type θ_i	prob	decision	entrepreneurs' contribution	lenders' contribution
$\theta_i \in [\underline{\theta}, \theta^s]$	$(1-\alpha)(1-\sigma)$	ref.	$\tilde{s}_t^E(\theta_i)$	$\theta_i - \tilde{s}_t^E(\theta_i)$
$\theta_i \in (\theta^s, \bar{\theta}]$	$(1-\alpha)\sigma$	liq.	–	–

There is then *Poor* projects' continuation (i.e. soft budget constraint) for the first group of *Poor* entrepreneurs, and liquidation for the other one. In case of refinancing, lenders' interim contribution is fixed, whereas entrepreneurs' contribution is increasing in types. In the second group, –high levels of θ– there is liquidation, so no contributions are involved.

We can now complete the description of lenders' participation constraint at the contracting stage, equation (8), by first writing the expected profits from funding a given *Poor* project

$$E(\Pi_P^L) = \sigma E(\Pi_{low}^L) + (1-\sigma)E(\Pi_{high}^L), \tag{16}$$

where $E(\Pi_{low}^L)$ is lender's net expected payoff if the project is liquidated, and $E(\Pi_{high}^L)$ is lender's net expected payoff if he funded a *high-ability* entrepreneur, weighted by their respective shares. These expected payoffs are, for $\theta_i \in (\theta^s, \bar{\theta}]$

$$E(\Pi_{low}^L) = R_L - R < 0, \tag{17}$$

and for $\theta_i \in [\underline{\theta}, \theta^s]$

$$E(\Pi_{high}^L) = \gamma R_S - R(1 + \hat{\theta} - \tilde{s}_t^E(\hat{\theta})) < 0,$$

where $\hat{\theta} = E(\theta \mid \theta \leq \theta^s(s_t^E))$ denotes the expected value of θ conditional on θ_i belonging to the relevant range for *high-ability* entrepreneurs. Note that, substituting the expression for $\hat{\theta} - \tilde{s}_t^E(\hat{\theta})$ –see equation (15)–, we can rewrite this equation as

$$E(\Pi_{high}^L) = \gamma R_S - R(1 + \frac{\gamma R_S - R_L}{R}) = R_L - R < 0. \tag{18}$$

This is the same expected payoff that a lender would get by terminating the project, since entrepreneurs need to contribute up to the point in which lenders are just indifferent between continuation and liquidation.

With these ingredients, we can rewrite lenders participation constraint at the contracting stage as

$$E(\Pi^L) = \alpha(\gamma R_S - R) + (1-\alpha)(R_L - R) \geq 0. \tag{19}$$

Equation (19) then governs lenders decision to fund projects at the contracting stage. This decision depends on the mix of *Good* and *Poor* projects in the entrepreneurs population given by the exogenous parameter α.

3.2.2 Entrepreneurs' investment decisions

The decision that an entrepreneur has to take at the contracting stage is whether or not to submit her project for funding. Given our setting it is straightforward to see that a *Good* entrepreneur will always submit her project: by doing so she gets a proportion $(1-\gamma)$ of the gross payoff without contributing to funding. Formally, she will submit it as long as

$$E(\Pi_G^E) = (1-\gamma)R_S \geq 0. \tag{20}$$

For a *Poor* entrepreneur, the decision to submit her project at the contracting stage will depend on the probability of being refinanced at the interim stage, and in such a case on the opportunity costs of the funds she will have to put. Recall that entrepreneurs have a primitive storage technology available, and that at the contracting stage they do not know their levels of ability, which is only revealed at the interim stage.

The *Poor* entrepreneur expected payoff if she submits her project is composed by two terms: First, if she turns out to be a *low-ability* entrepreneur, with probability $\sigma(s_t^E)$, her project will be liquidated so her payoff will be zero. And second, in the case she is a *high-ability* entrepreneur, which occurs with probability $\big(1-\sigma(s_t^E)\big)$, she will be allowed to continue provided she contributes at interim with an amount $\tilde{s}_t^E(\theta_i)$. Then, the *Poor* entrepreneur's participation constraint at the contracting stage is given by

$$(1-\sigma)\left[(1-\gamma)R_S - \hat{R}\tilde{s}_t^E(\hat{\theta})\right] > 0. \quad (21)$$

This individual rationality constraint tells us that, in order that a *Poor* entrepreneur submit her project when young, the expected payoff from it must be greater than zero. Notice that if the liquidation probability is equal to one, these entrepreneurs are not willing to submit their projects. They know ex-ante that they will be liquidated for sure. This equation illustrates expectations of a future bailout, their decision will depend on the current level of entrepreneurial savings, s_t^E.

At the interim stage, we saw that lenders may extend refinancing to *high-ability* entrepreneurs. Once entrepreneurs' abilities become observed, these entrepreneurs will be willing to be refinanced if the gross expected payoff from the project exceeds their respective opportunity cost of funds, i.e. if

$$(1-\gamma)R_S \geq \hat{R}\tilde{s}_t^E(\theta_i), \quad \text{for} \quad \theta_i \leq \theta^s(s_t^E)$$

In order that every high-ability *Poor* entrepreneur may be willing to continue, it must be the case that

$$(1-\gamma)R_S \geq \hat{R}s_t^E,$$

since the maximum value of $\tilde{s}_t^e(\theta_i)$ is s_t^E, when $\theta_i = \theta^s(s_t^E)$.

3.3 Equilibrium in the credit market

Proposition 1 *Soft budget constraint equilibrium. If*

- $\alpha \geq \frac{R-R_L}{\gamma R_S - R_L} \equiv \underline{\alpha}$
- $(1-\gamma)R_S \geq 0$
- $(1-\sigma)\left[(1-\gamma)R_S - \hat{R}\tilde{s}_t^E(\hat{\theta})\right] > 0$
- $\gamma R_S - R(\theta_i - \tilde{s}_t^E) \geq R_L.$

- $(1-\gamma)R_S \geq \hat{R}s_t^E$.

there exists an equilibrium with soft budget constraint.

Proof. The first equation is lenders' participation constraint at the contracting stage, equation (19), it states that in order to finance any project, the proportion of *Good* projects must be higher than a threshold $\underline{\alpha}$. The second and third equations are the entrepreneurs participation constraints at the contracting stage. The forth equation is the continuation rule for *Poor* projects, which acts as a participation constraint for lenders at the interim stage. Finally, the last equation is the participation constraint of *Poor* entrepreneurs at interim. If all of these conditions hold, we have an equilibrium in which all project are initially funded and some *Poor* projects end up refinanced, i.e. the equilibrium entails soft budget constraint. □

In the soft budget constraint equilibrium, lenders refinance a fraction

$$1-\sigma(s_t^E)) = \theta^s(s_t^E) - \underline{\theta}$$

of *Poor* projects. The asymmetric information structure of the model entails the financing of *Poor* projects. Moreover, some of them are refinanced and thus completed, despite being inefficient from an ex-ante point of view. Finally, for the remaining *Poor* entrepreneurs (in fraction $\sigma(s_t^E) = \bar{\theta} - \theta^s(s_t^E)$) there will be liquidation, since they are inefficient even from an ex-post perspective.

3.4 Size of the bailout

Given the equilibrium with soft budget constraint, it is interesting to calculate the amount of funds lenders put at the interim stage. This will give us the size of the bailout *Poor* entrepreneurs receive from lenders. We have found that extra funding may be extended to *high-ability Poor* entrepreneurs, i.e. for ability levels $\theta_i \in [\underline{\theta}, \theta^s(s_t^E)]$. The bailout size b is a function of entrepreneurial savings s_t^E, and is given by

$$b(s_t^E) = \eta(1-\alpha)\int_{\underline{\theta}}^{\theta^s(s_t^E)} \Big(\frac{\gamma R_S - R_L}{R}\Big) f(\theta) d(\theta).$$

This measure of the financial help extended to *Poor* entrepreneurs can reveal itself helpful on comparing the model's results with the empirical evidence. For that, we can propose a relative indicator which is the ratio between the bailout size and the total number of funded projects (η). We can also compare the bailout size with the number of *Good* projects ($\alpha\eta$). As a macroeconomic indicator, aggregate (per capita) credit is given by

$$C_t = \Big\{1 + (1-\alpha)\left[\theta^s(s_t^E) - \underline{\theta}\right]\left(\frac{\gamma R_S - R_L}{R}\right)\Big\}\eta, \tag{22}$$

that is, total per capita credit is composed by the initial investment plus the funding at the interim stage given to *Poor* projects, which depends on entrepreneurial savings. Finally, it is straightforward to obtain the Credit to GDP ratio, C_t/y_t.

4 Physical Capital Formation

In this section we show how the expected price and quantity of physical capital are determined. In any period t, the inherited per capita capital stock k_t is given, labor supply is inelastic, so output is determined by the production function and the realization of the productivity shock $\tilde{\epsilon}_t$, according to equation (4). Therefore, wages and both entrepreneurs and lenders' period-t savings are determined, as well as $\theta^s(s_t^E)$.

Given the presence of asymmetries of information in the credit market, we know it can be the case that some *Poor* projects get refinanced and thus completed. This means the supply of physical capital available to use in the next period (k_{t+1}) is the weighted sum of the units of capital (κ) produced by *Good* entrepreneurs and those produced by *Poor* entrepreneurs that get refinancing. The new capital supply curve, that we call $S'S'$ for the imperfect information case, writes as follows

$$k_{t+1} = \alpha\kappa\eta + (1-\alpha)(1-\sigma(s_t^E))\kappa\eta = \Big\{\alpha + (1-\alpha)[\theta^s(s_t^E) - \underline{\theta}]\Big\}\kappa\eta, \tag{S'S'}$$

which is an upward sloping curve in the space $(k_{t+1}, \hat{q}_{t+1})$ since $\theta^s(s_t^E)$ depends on $\hat{q}_{t+1}$. This is the key macroeconomic dynamic equation that connect the economic conditions of any period to the next. The demand curve for capital DD is just the same as in the perfect information case,

$$\hat{q}_{t+1} = \epsilon f'(k_{t+1}). \tag{DD}$$

In each period t, $\hat{q}_{t+1}$ and k_{t+1} are determined as the intersection of the supply and demand curves of capital (see Figure 4). From the $S'S'$ curve it is easy to

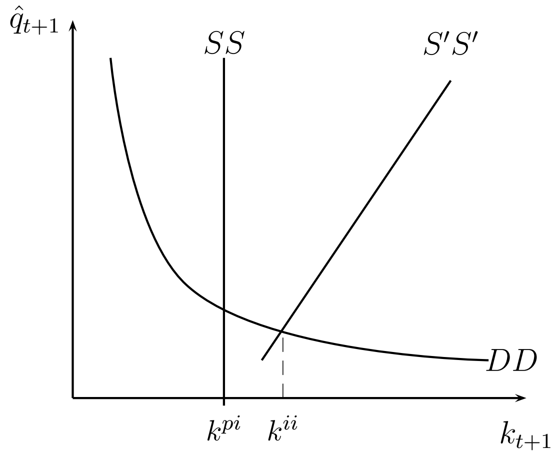

Figure 4: Equilibrium in the soft budget constraint case

see that, in the presence of asymmetric information in the credit market, the equilibrium may entail a level of physical capital strictly greater than the perfect information one. This is the case when refinancing of *Poor* projects occurs, i.e. when $\theta^s(s_t^E) > \underline{\theta}$.

In a simple exercise of comparative statics, consider the effects of a rise in current production following a positive and temporary shock. Let us suppose that the initial situation is one in which the level of entrepreneurial savings is low enough such that $\theta^s(s_t^E) = \underline{\theta}$, that is, all *Poor* entrepreneurs are *low-ability* ones, and there is liquidation for any *Poor* submitted project. We are then reproducing the perfect information outcome, $k_{t+1} = \alpha\kappa\eta$. The situation is illustrated in Figure 5. The direct effect is a rise in current entrepreneurs' (and lenders') savings, and consequently an increase in the number of *Poor* projects that are refinanced, since $\theta^s(s_t^E)$ grows. This in turn shifts the $S'S'$ curve to the right, and the within-period equilibrium is obtained for a higher level of capital k_{t+1}.

Notice, by the contrary, that a negative shock occurring under the same initial situation as the one described above[10], would have no effect on investment. This is so since all *Poor* entrepreneurs, that are already rationed, would not be able to get refinancing. This allows us to propose the following:

Proposition 2 *The soft budget constraint problem is more binding during expansions: The economy produces more capital than in the perfect information case.*

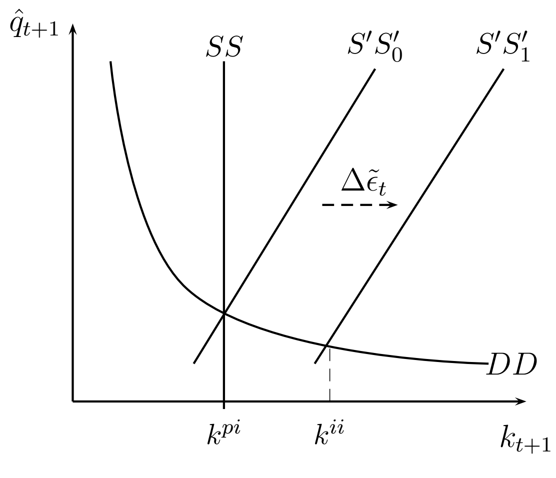

Figure 5: Effects of a productivity shock

In what concerns the inter-temporal equilibrium characterization, no general steady state existence results are obtained, but we can provide examples with spe-

[10]We think in a small negative and temporary shock, such that it does not imply a credit crunch for *Good* projects too.

cific production functions and parameter configurations for which an equilibrium exists. This is done in Section 6.

5 Assessing on the role of SBC in general equilibrium

We have seen that the main outcome of the syndrome on our setting is overinvestment. We now investigate what are the effects of this result in this general equilibrium setting. For that, we could take different avenues. For instance, and going beyond the model proposed here, imagine a broader setting which includes two sectors, one which faces the syndrome and the other that do not. In that case, overinvestment in the first sector would be meaning that there is underinvestment in the other, since refinancing of *Poor* projects in the first sector deviates resources that could have been invested in the second sector. Similar results are found in Berglöf and Roland (1997), where lenders have the option to either refinance *Poor* projects or finance new ones. If the average quality of new projects is low, lenders will refinance old ones. Consequently there is credit rationing in new investment together with soft budget constraint.

A second avenue, now within our model, consists in calculating the second period expected consumption of individuals. The class of entrepreneurs is not affected by the presence of soft budget constraint, since their expected payoffs from projects are always at least equal than their outside option, the primitive storage technology that returns the gross rate $\hat{R} < 1$. Indeed, *Good* entrepreneurs always make positive expected profits, while *Poor* entrepreneurs –even in the case they are liquidated– get at least the rate $\hat{R}$.

Lenders do suffer from it. To see how, let us consider the two possible uses of lenders' savings during the first period: either funding projects or using the storage technology. Let us then define the weights δ, which express the fractions of lenders that finance projects (*Good* and *Poor* in all of its variant)), or that simply use the storage technology:

- $\delta_3 = \frac{\alpha\eta}{1-\eta}$ share of lenders who finance *Good* projects;
- $\delta_2(s_t^E) = \frac{(1-\alpha)\eta\sigma(s_t^E)}{1-\eta}$ share of lenders who finance *low-ability Poor* projects (liquidation);
- $\delta_1(s_t^E) = \frac{(1-\alpha)\eta(1-\sigma(s_t^E))}{1-\eta}$ share of lenders who finance *high-ability Poor* projects (SBC);
- $\delta_0 = \frac{1-2\eta}{1-\eta}$ share of lenders who simply store their savings.

Proposition 3 *Let c_{t+1}^{pi} and c_{t+1}^{ii} be the expected second period consumption of lenders for respectively the perfect and imperfect information cases. Then, $c_{t+1}^{pi} > c_{t+1}^{ii}$.*

Proof. Notice the dependence of δ_1 and δ_2 on entrepreneurial savings, since those are functions of $\sigma(s_t^E)$. The expected second period consumption of lenders in the imperfect information case (c_{t+1}^{ii}) is thus given by

$$c_{t+1}^{ii} = \delta_3 c_{t+1}^{G} + \delta_2 c_{t+1}^{P,low} + \delta_1 c_{t+1}^{P,high} + \delta_0 c_{t+1}^{Stor}. \tag{23}$$

In turn, these expected levels of consumption are given by the sum of the gross payoffs from projects and from storage. In the case of funding a *Good* project, the expected second-period consumption writes:

$$c_{t+1}^{G} = \gamma\hat{q}_{t+1}\kappa + R(s_t - 1). \tag{24}$$

Those lenders that funded *low-ability* entrepreneurs (and hence their projects are liquidated at interim) get:

$$c_{t+1}^{P,low} = R_L + R(s_t - 1). \tag{25}$$

When lenders have funded a *high-ability* entrepreneur, the project is completed and thus their payoff is:

$$c_{t+1}^{P,high} = \gamma\hat{q}_{t+1}\kappa + R(s_t - 1 - \frac{\gamma\hat{q}_{t+1}\kappa - R_L}{R}) = R_L + R(s_t - 1). \tag{26}$$

Finally, for the case of lenders that can only store (no investment opportunities left for them):

$$c_{t+1}^{Stor} = Rs_t. \tag{27}$$

Notice that

$$c_{t+1}^{G} > c_{t+1}^{Stor} > c_{t+1}^{P,high} = c_{t+1}^{P,low}. \tag{28}$$

On the other hand, in the perfect information case (pi), lenders only fund *Good* projects, so their expected second period consumption c_{t+1}^{pi} is given by

$$c_{t+1}^{pi} = \delta_3 c_{t+1}^{G} + (1-\delta_3) c_{t+1}^{Stor}. \tag{29}$$

We next show that the expected second period consumption of lenders is greater in the perfect information case: $c_{t+1}^{pi} > c_{t+1}^{ii}$, i.e.

$$\delta_3 c_{t+1}^{G} + (1-\delta_3) c_{t+1}^{Stor} > \delta_3 c_{t+1}^{G} + \delta_2 c_{t+1}^{P,low} + \delta_1 c_{t+1}^{P,high} + \delta_0 c_{t+1}^{Stor}, \tag{30}$$

which can be re written, using the above facts as

$$(1-\delta_3-\delta_0) c_{t+1}^{Stor} > (\delta_1+\delta_2) c_{t+1}^{P,low}, \tag{31}$$

and $(1-\delta_3-\delta_0) = \delta_1+\delta_2$ so the above expression shrinks to

$$c_{t+1}^{Stor} > c_{t+1}^{P,low}. \tag{32}$$

This expression holds by construction, then we have proven that $c_{t+1}^{pi} > c_{t+1}^{ii}$. $\square$

In the soft budget constraint economy, then, lenders when old can consume less compared to what they would obtain in an economy with perfect information, in which only *good* projects are financed.

6 Dynamics

As we have mentioned in sub-section 3.1, the perfect information case presents no interesting dynamics: the capital stock is fixed and production only varies with the productivity shock $\tilde{\epsilon}_t$. In the imperfect information case, the capital supply curve $S'S'$ depends on current entrepreneurial savings s_t^E which implies that this curve will react to changes in period-t capital stock, as well as to productivity shocks, since both affect the marginal productivity of labor and thus the level of savings. There is no such effect in the perfect information setting.

Consider again the effects of a positive (temporary) shock occurred in period T. If the economy is in its steady state (assuming by the moment that a steady state exists) the immediate effect of the shock is an increase of entrepreneurs' savings and then, via the $S'S'$ curve, the capital available in $T+1$ will increase above the level it would have had without the shock. This will in turn increase the next period entrepreneurial savings over its steady state level, propagating the initial effect. The expected price of capital $\hat{q}_{T+1}$ will decrease in period T, and eventually it will increase enough so as to compensate the effects of the shock, and the steady state is recovered. A negative shock would have the opposite effects, i.e. a persistent investment downturn. Since we are unable to say more at this stage, we next propose an example with functional forms.

6.1 Cobb-Douglas, uniform ability economy

In order to know more about the dynamic characteristics of the model, we consider in this sub-section an example based on a Cobb-Douglas production function with parameter β. Equation (4) is then

$$y_t = \tilde{\epsilon}_t f(k_t) = \tilde{\epsilon}_t k_t^{\beta}. \tag{33}$$

Recall the capital supply ($S'S'$) curve

$$k_{t+1} = \left\{\alpha + (1-\alpha)[\theta^s(s_t^E) - \underline{\theta}]\right\}\kappa\eta. \tag{S'S'}$$

The capital demand curve (DD) is:

$$\hat{q}_{t+1} = \epsilon\beta k_{t+1}^{\beta-1}. \tag{DD}$$

Now entrepreneurial savings s_t^E writes, using equation (1),

$$s_t^E = \tilde{\epsilon}_t(1-\beta)k_t^{\beta}L,$$

which, according to equation (11), determines the threshold $\theta^s(s_t^E)$

$$\theta^s(s_t^E) = \frac{\gamma \hat{q}_{t+1}\kappa - R_L}{R} + \tilde{\epsilon}_t(1-\beta)k_t^{\beta}L. \tag{34}$$

Next, let us insert both the expression for $\hat{q}_{t+1}$ given by equation (DD), and that for $\theta^s(S_t^e)$ (given by equation (34)) into equation (S'S'), then the equilibrium path is described by the following dynamic equation:

$$k_t = \left[\frac{G(k_{t+1})}{(1-\beta)\tilde{\epsilon}_t L}\right]^{1/\beta}, \tag{35}$$

where

$$G(k_{t+1}) = \frac{k_{t+1}}{(1-\alpha)\kappa\eta} - \frac{\gamma\epsilon\kappa\beta k_{t+1}^{\beta-1}}{R} - \frac{\alpha}{1-\alpha} + \frac{R_L}{R} + \underline{\theta}. \tag{36}$$

i.e. the general form of the dynamic path is

$$k_t = H(k_{t+1})$$

To advance one step further in the analysis, it is necessary to impose values to the parameters. We can easily show that $H'(k_{t+1}) > 0$ and $H''(k_{t+1}) < 0$, but we do not know whether $H(0) > 0$ or $H(0) < 0$. Let us thus next configure a parametrical example for this Cobb-Douglas case. Those values are presented in Table 2.

For this parameter configuration, all the imposed restrictions for existence of a SBC equilibrium are satisfied. This means that lenders fund all projects at the contracting stage, all *Poor* entrepreneurs submit their projects for funding, and some of them gets refinancing at the interim stage. Given the assumptions we made to guarantee the existence of both *Good* and *Poor* projects, this analysis is restricted for an interval of capital such that $k_t \in (k_{min}, k_{max})$.

Using equation (35) with $k_t = k_{t+1} = k^{ss}$ and our parameter set, we found that there exists a unique steady state (see Figure 6), and that $k^{ss} \in (k_{min}, k_{max})$. Moreover, this steady state is characterized by the presence of *soft budget constraint* refinancing of *Poor* entrepreneurs. Further simulations have revealed that those results are quiet robust to the parameter choice. We wanted to know how

Table 2: Choice of parameters

Parameter	Value	Definition
η	0.30	% of entrepreneurs in population
α	0.70	% of *Good* projects among entrepreneurs
κ	15	physical capital units that yields a completed project
γ	0.85	fraction of projects' gross payoff to lenders
θ_i	$U[1,2]$	distribution of ability among *Poor* entrepreneurs
R_L	0.80	liquidation value of projects
R	1.10	gross return from storage (lenders)
$\hat{R}$	0.70	gross return from storage (entrepreneurs)
β	0.30	capital parameter in Cobb-Douglas production function
$\epsilon = \tilde{\epsilon}_t$	1.00	no shocks
L	1.00	labor endowment

well this model behaves when we modify some key parameters. In particular, we have conducted examples varying the parameter α that accounts for the proportion of *Good* projects in the population of entrepreneurs. Starting from the initial 70% we used above, we have decreased α by ten percentage points at each time, and we found existence of steady states with *soft budget constraint* equilibria, even for a low 40% of *Good* projects. For lower values of α, the participation constraint of lenders at the contracting stage is not satisfied.

In another simulation, again with $\alpha = 0.7$, we modified the parameter η, the percentage of entrepreneurs in the total population. This resulted in a more constrained range: steady state existence with soft budget constraint is guaranteed for $\eta \in [0.2, 0.3]$. Finally, combining both ranges i.e. $\alpha \in [0.4, 0.7]$ and $\eta \in [0.2, 0.3]$, we still find existence. We conclude then that there exists a relatively large range of two crucial parameters for which there exists steady states characterized by soft budget constraint.

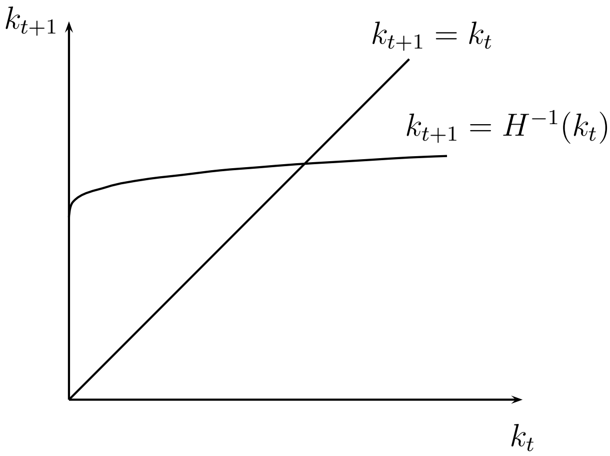

Figure 6: Intertemporal equilibrium existence - SBC case

The effects of a period-T positive and temporary shock on the most relevant variables of the model are shown in Figure 7. We present both the perfect information (*pi*) and the imperfect information (*ii*) cases. The shock provokes an increase in period-T entrepreneurial wealth, measured in this setting by entrepreneurial savings s_t^E. The consequences of this rise are different in both cases. We have mentioned before that in the perfect information case investment is fixed so that any shock affecting savings is absorbed by consumption and inventories. In the imperfect information case, it turns out that the shock has an effect on investment (k_{t+1}), that grows as immediate effect following the increased balance sheet positions of entrepreneurs. This effect persists thereafter through a higher than steady state level of entrepreneurial savings. The opposite occurs for the expected price of physical capital ($\hat{q}_{t+1}$), that acts as counterbalance to recover the steady state. We hence find persistence of the shock, due to the channel between entrepreneurial savings and the decisions to refinance, as well as procyclicality since expansions tend to amplify the soft budget constraint syndrome.

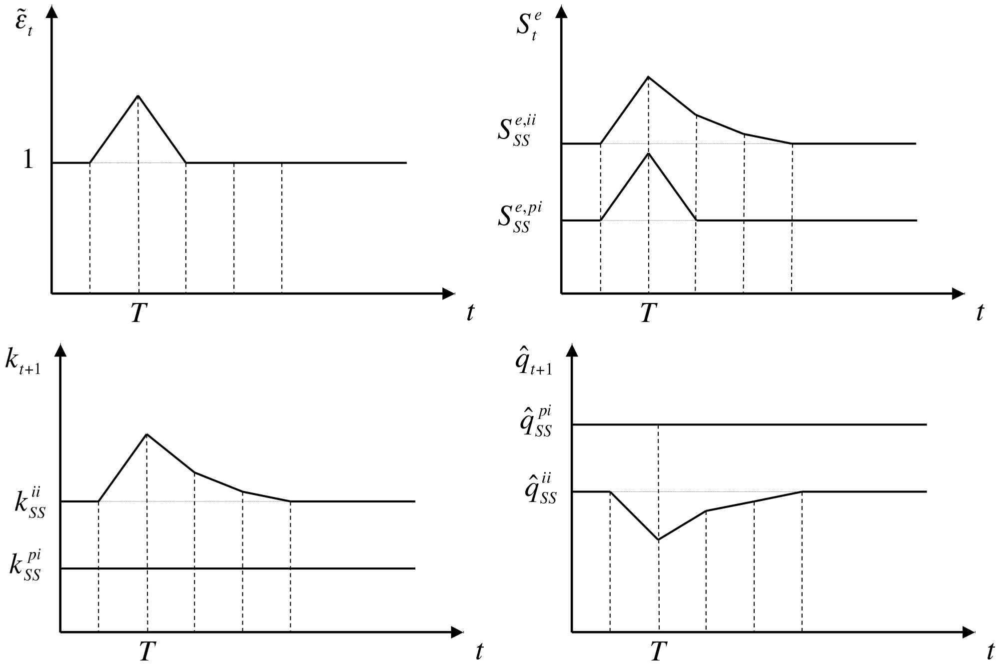

Figure 7: Adjustment after a period-T shock

7 Econometric specification

In this section we analyze empirically a prediction of the model, which is the fact that the response of credit facing output expansions is larger in SBC economies compared to economies in which constraints are "hard". To do that we propose a panel of 32 countries for the 1972-1999 period, with annual data. The data is presented in Table 3, countries include developed economies, Latin American countries and South East Asia countries.

Credit (C) –expressed in local currency in current terms– comprises claims on the nonbanking private sector by commercial banks and other financial institutions, lines 22d and 42d of International Financial Statistics, IMF. The Gross Domestic Product (Y) is also obtained from IFS (line 99d). We denote the variation in per capita real GDP as Δ ln $Y_{i,t}$, using data from the Penn World Table. Descriptive statistics are presented in Table 3.

Table 3: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
C/Y	903	.5583	.3382	.08887	1.77132
Δ ln Y	952	.0284	.0208	-.07347	.147185

Countries: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, UK, USA. Argentina, Brazil, Chile, Colombia, Mexico, Paraguay, Peru, Uruguay, Venezuela. Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand.

We run the following regression, using the Fixed Effects model:

$$(C/Y)_{i,t} = \alpha_i + \beta_1 \Delta\, ln\, Y_{i,t} + \beta_2(\Delta\, ln\, Y_{i,t} \times Dummy_{Lat}) + \beta_3(\Delta\, ln\, Y_{i,t} \times Contract_i) + u_{i,t}$$

We explain the credit to GDP ratio using per capita GDP growth. This allows to control for the impact of rapidly growing economies into the demand for credit. Since in our model the SBC phenomenon arises in economies with low levels of screening and monitoring, we consider that this can have been the case for many Latin American countries. We then include the variable $Dummy_{Lat}$ which adopts the value one for these countries, expecting to obtain higher responses of the Credit to GDP ratio facing output booms, i.e. $\beta_2 > 0$.

We also include the cross variable (Δ ln $Y_{i,t} \times Contract_i$), where "Contract" measures the relative degree to which contractual agreements are honored and complications presented by language and mentality differences. Scored 0-4, with higher scores for superior quality; average over 1980-95; Source: Knack and Keefer (1995), using data from Business Environmental Risk Intelligence (BERI). We guess that a better institutional framework, captured by higher values of "Contract", would be translated by a lower response of the Credit to GDP ratio. We are thus expecting the coefficient β_3 to be negative. The results of this regression

Table 4: Explaining the Credit to GDP ratio

Dependent variable: Credit to GDP ratio, 1972-1999				
Coefficient	Model			
	I	II	III	IV
α_i	0.656**	0.694**	0.735**	0.740**
	(0.011)	(0.011)	(0.012)	(0.012)
β_1	-3.409**	-5.885**	7.633**	3.588*
	(0.308)	(0.408)	(1.218)	(1.661)
β_2	–	5.191**	–	2.738**
		(0.590)		(0.771)
β_3	–	–	-4.822**	-3.564**
			(0.507)	(0.615)
Observations	821	821	821	821

are presented in Table 4, where we see we find the expected parameter signs: Latin American countries present a higher response of credit following output growth, whereas the qualitative variable indicates countries with a better institutional environment show a lower response of credit.

8 Conclusions

We have constructed a model in which soft budget constraint phenomena appear as a result of adverse selection in credit markets. Any ex-ante liquidation threat by the part of lenders may not be credible for some levels of entrepreneurial savings, which determines that *Poor* projects are submitted to funding and some of them get refinancing. The model then reproduces one of the main ingredients of this syndrome: when expectations of a future bailout are positive, then liquidations threats may not be credible enough so as to deter entrance of *Poor* projects.

As we have seen, the problem is more binding during “good times”, i.e. when entrepreneurs net worth is high. In such situations creditors are more indulgent with borrowers, and thus a greater number of *Poor* projects finishes completed. In this way, the model is able to reproduce some stylized facts observed in particular in Uruguay and Argentina during the late seventies, in the context of financial liberalization processes and the international bonanza in capital markets. In that period, bank lending has gone through a great expansion and there is evidence that project screening and monitoring were at best reduced. The initial funding as well as the refinancing of non-performing projects were therefore highly likely. To give a very illustrative example of the aggressive behavior of banks in giving loans, the popular saying during the credit boom in Uruguay was: “You could never get less than twice the money you asked for”[11]. Once the recession came in the early eighties, this followed by generalized bankruptcy episodes together with other forms of bailouts and rescues, this time sponsored by the government, such as refinancing and moratoria laws, nationalization processes, soft credit and tax arrears. But that is the other side of the coin.

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